

1. A method of forming a layered article, the method comprising:

thermoforming a substrate sheet to form a shaped substrate, wherein the shaped substrate is a fiber-reinforced plastic material having a void content sufficient to allow a vacuum to be applied through the shaped substrate;

pulling a vacuum through the shaped substrate; and

pulling a film layer onto a surface of the shaped substrate to form the layered article.

2. The method of Claim 1, wherein the film layer further comprises a compatible layer.

3. The method of Claim 1, wherein the void content is greater than or equal to about 5 vol.%, based on the total volume of the shaped substrate.

4. The method of Claim 3, wherein the void content is about 10 vol.% to about 50 vol.%.

5. The method of Claim 4, wherein the void content is about 25 vol.% to about 50 vol.%.

6. The method of Claim 1, wherein the fibers have a fiber diameter of about 6 micrometers to about 25 micrometers, and a fiber length of about 2 millimeters to about 75 millimeters.

7. The method of Claim 1, wherein the shaped substrate is forminated.

8. The method of Claim 1, wherein the shaped substrate is an open-celled, fiber-reinforced plastic material.

9. The method of Claim 1, wherein the substrate sheet comprises:
about 25 wt.% to about 75 wt.% plastic material;
about 25 wt.% to about 75 wt.% fibers; and
wherein weight percents are based on a total weight of the substrate sheet.

10. The method of Claim 9, wherein the substrate sheet comprises:
about 35 wt.% to about 65 wt.% plastic material; and
about 35 wt.% to about 65 wt.% fibers.

11. The method of Claim 9, wherein the plastic material is selected from the group consisting of polycarbonate, polyester, polyetherimide, polyphenylene ether, polystyrene, polyamide, and combinations comprising at least one of the foregoing.

12. The method of Claim 1, wherein the substrate sheet is thermoformed with a membrane assisted vacuum pressure forming method with a plug-assist.

13. The method of Claim 1, further comprising disposing a tie-layer between the shaped substrate and the film layer.

14. The method of Claim 1, wherein thermoforming the substrate sheet further comprises heating the substrate to a temperature sufficient to allow lofting of the fibers.

15. The method of Claim 14, wherein the temperature is about 450°F (about 232°C) to about 700°F (about 371°C).

16. The method of Claim 1, wherein the substrate sheet further comprises a non-woven scrim disposed on a surface of the substrate sheet.

17. A method of forming a layered article, the method comprising:

heating a substrate sheet to a temperature sufficient to allow lofting of fibers of the substrate sheet;

disposing the substrate sheet against a membrane assisted pressure box;

pushing the substrate sheet onto a mold to form a shaped substrate;

heating a film layer;

disposing the film layer adjacent to the shaped substrate;

pulling a vacuum through the shaped substrate; and

pulling the film layer against the shaped substrate to form the layered article.

18. The method of Claim 17, wherein the shaped substrate is a fiber-reinforced plastic material having a void content of greater than or equal to about 5 vol.%, based upon the total volume of the shaped substrate.

19. The method of Claim 18, wherein the void content is about 10 vol.% to about 50 vol.%.

20. The method of Claim 17, further comprising disposing a tie-layer between the shaped substrate and the film layer.